

REMARKS

Claims 1-5, 7-9, and 11-16 are presently pending in the application.

Claim 1 has been amended to correct a misplaced modifier and make clear that the layer of manganese compound is on a surface of the positive electrode plate. Claims 7-8 and 11-15 have been rewritten to incorporate the subject matter of claim 6 or 10, respectively, as suggested by the Examiner in Paper No. 4, and claim 9 has been amended to depend from claim 8. New claim 16 recites that the layer on a surface of the positive electrode plate contains only manganese as a metallic element. Support for this amendment may be found at least in the Examples in the specification, in which the layer of the manganese compound does not contain any other metallic element, such as cobalt or nickel. No new matter has been added by these amendments, and entry is respectfully requested.

Applicants respectfully submit that claims 7-9 and 12-15 as amended are now allowable since, as acknowledged by the Examiner in Paper No. 4, none of the prior art teaches forming a manganese coating layer on a nickel hydroxide active material for an alkaline battery by immersing the substrate in a saturated alkaline solution containing manganese ions, nor incorporating manganese compounds or metal in either the separator or the negative electrode plate.

The Examiner has rejected claims 1-3, 5, 6, 10, and 11 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,548,210 of Shinyama et al. ("Shinyama") and has further rejected claim 4 under 35 U.S.C. § 103(a) as being unpatentable over Shinyama. Claims 1-3, 5, 6, 10, and 11 have been rejected further under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,613,107 of Tamagawa et al. ("Tamagawa"). Applicants respectfully traverse these rejections and the arguments in support thereof as follows, and respectfully request reconsideration and withdrawal of the rejections.

Rejection Under §102(e) Based on Shinyama

The Examiner argues that Shinyama teaches nickel electrodes for alkaline batteries which are formed by impregnating a sintered, porous nickel substrate with an aqueous solution of nickel nitrate and cobalt nitrate, and then dipping the substrate into a sodium hydroxide solution. A solid solution of nickel and cobalt hydroxide (which is the electrode active material) is thus allegedly filled into the porous nickel substrate. The Examiner argues that a coating layer is subsequently formed over the active material layer, which coating layer may be a combination of nickel hydroxide and manganese hydroxide or of cobalt and manganese hydroxides. Regarding claim 3, the Examiner contends that the example of Shinyama using cobalt and manganese will have cobalt hydroxide on the electrode active material outer surface. Regarding claim 5, the Examiner contends that the electrodes disclosed by Shinyama are used in alkaline secondary batteries having a hydrogen storage alloy as a negative electrode, a polyolefin separator and an alkaline electrolyte. Finally, regarding claim 10, the Examiner argues that the formation of a manganese hydroxide layer disclosed by Shinyama is considered to "cause the positive electrode to retain a manganese compound", i.e., manganese hydroxide. Applicants respectfully traverse this rejection as follows.

In one aspect of the Shinyama invention, a nickel electrode for alkaline secondary batteries includes a porous sintered nickel substrate loaded with a nickel hydroxide-based active material, in which the nickel electrode contains a layer between a surface portion of the active material on the substrate and the active material. This layer is based on a complex compound of cobalt and/or nickel and at least one of manganese, aluminum, iron, copper and silver (col. 7, lines 5-15). Shinyama teaches that this layer prevents the electrolyte from coming in contact with the active material and the sintered nickel substrate and also prevents self discharge due to oxygen evolution during storage of the battery under high temperature conditions, thus improving high temperature storability (col. 7, lines 31-34). Further, the complex compound allegedly suppresses the expansion of the nickel electrode, thereby improving the charge/discharge cycle characteristics of the battery.

In contrast, according to the present invention, a nickel-metal hydride storage battery may be achieved which exhibits excellent self-discharge resistance, high working voltage during discharging, high utilization of the active material at a high temperature, and long life. These benefits may be achieved by incorporating cobalt, zinc or magnesium, and manganese into the active material nickel hydroxide, as well as by forming a layer of a manganese compound containing manganese with a valence of two or more on the surface of the nickel positive electrode plate. By including this layer of high-valent manganese, cobalt ions trying to migrate to the separator are oxidized and captured by the layer so that no cobalt is present in the separator. That is, dissolution of cobalt from the positive electrode in the battery, which typically occurs when the battery voltage is decreased, is suppressed. Accordingly, the formation of a minute chemical short circuit between the positive and negative electrodes is prevented even when the battery is recharged.

The layer of a manganese compound in the present invention is found on the surface of the positive electrode plate, which contains a substrate of sintered nickel and an active material. In contrast, as shown in Fig.1, Shinyama teaches a coating layer formed on the nickel hydroxide-based active material, not on the sintered nickel substrate. As described in a comparative example in the present application at page 30, lines 9-19, when a manganese compound coated the surfaces of the positive electrode active material and the current collector rather than the surface of the positive electrode plate, an inferior battery resulted. Therefore, it is important for the present invention that the manganese layer be on the surface of the positive electrode plate.

In a preferred embodiment of the present invention, as claimed in new claim 16, the layer of high-valent manganese, which contributes to the desirable properties of the resulting battery, contains only manganese as a metallic element; no nickel or cobalt is present in this layer, as in the layer of Shinyama. Furthermore, the coating layers of Shinyama, which are alleged by the Examiner to be equivalent to the claimed layer containing high-valent manganese, contain nickel or cobalt hydroxide and manganese hydroxide.

For all of these reasons, Shinyama does not teach all of the elements of claim 1 or of dependent claims 2, 3, or 5, and reconsideration and withdrawal of the §102(b) rejection are respectfully requested.

Regarding claim 11, the Examiner has not explained how Shinyama teaches or suggests all of the claimed elements. As recited in claim 11, a manganese compound containing manganese with a valence of two or more is applied to a surface of the positive electrode plate. The Examiner contends that Shinyama describes the formation of a manganese hydroxide layer. However, in Shinyama, a nickel substrate is dipped into a solution of manganese nitrate, dried and subsequently dipped into a solution of sodium hydroxide to convert the manganese nitrate into manganese hydroxide. Thus, Shinyama synthesizes manganese hydroxide on the nickel substrate, i.e., on the electrode. In contrast, according to the method of claim 11, a manganese compound of the required valence is applied onto the positive electrode plate. This permits omission of steps of using an alkali solution, such as sodium hydroxide, subsequent washing with water, and drying. Hence, the method of claim 11 is much simpler than that of Shinyama. Accordingly, Shinyama does not teach or suggest all of the elements of claim 11, and withdrawal of the §102(b) rejection is respectfully requested.

Rejection Under §103(a) Based on Shinyama

The Examiner acknowledges, regarding claim 4, that Shinyama does not disclose a coating layer thickness of between 0.1 microns and 20 microns. However, the Examiner argues that Shinyama teaches a coating layer weight of 5 to 6 mg/cm² and, since the theoretical density of manganese hydroxide is about 3.26 g/cm³, calculates that a 100% dense layer of manganese hydroxide would be about 1.5 microns thick. The Examiner concludes that one of ordinary skill in the art would understand that while the actual layer thickness would be somewhat greater than this, the Shinyama disclosure would encompass the claimed thickness. Applicants respectfully traverse this rejection as follows.

As previously explained, Shinyama does not teach or suggest a layer of high-valent manganese on the surface of the positive electrode plate, but only on the nickel-hydroxide-based active material. Furthermore, whereas claim 4 recites that the layer of high-valent manganese has a particular thickness, Shinyama teaches the weight per unit area of the coating layer containing complex hydroxides of two different metallic elements, such as cobalt or nickel. It is not possible to determine the thickness of only the manganese-containing layer, as claimed, since the layers contain two complex hydroxides. Accordingly, Shinyama does not teach or suggest the claimed elements, and no *prima facie* case of obviousness has been established based on Shinyama.

However, even if such a *prima facie* case had been established, Shinyama does not realize the criticality of the claimed thickness range, and the unexpected results which are achieved by utilizing such thicknesses would overcome any such case of obviousness. Specifically, as explained in the present application, in order to achieve the benefits of Applicants' invention it is desirable that the layer of manganese have a thickness of 0.1 to 20 μm . If the thickness is less than 0.1 μm , the effect of reducing the oxidation rate of hydrogen in the positive electrode active material becomes small and the dissolution of cobalt from the positive electrode is not sufficiently suppressed, so that the effect of improving the self-discharge resistance decreases. In contrast, when the thickness of the layer is too high, while the oxidation rate of hydrogen and the dissolution of cobalt ion suppression are in the desirable range, the charge efficiency of the active material decreases. Based on these unexpected results, even if a *prima facie* case of obviousness had been established, it would be overcome, and reconsideration and withdrawal of the rejection are respectfully requested.

Rejection Under §102(e) Based on Tamagawa

The Examiner contends that Tamagawa discloses nickel hydroxide electrodes for alkaline batteries which include a coating layer of metal oxide over the surface of the active material. The electrodes are allegedly produced by forming a porous nickel sintered substrate; impregnating the substrate with active material, including nickel oxyhydroxide; immersing the active material loaded substrate in an acid salt solution of elements including manganese; and treating the electrode with alkali to form a metal hydroxide layer. The active material allegedly contains cobalt and cadmium in addition to nickel. Accordingly, the Examiner contends that cobalt hydroxide is included on the surface of the active material, since the cobalt will be found throughout the active material. Further, nickel cadmium alkaline batteries are allegedly disclosed, and the formation of a manganese hydroxide layer as disclosed by Tamagawa is considered to "cause the positive electrode to retain a manganese compound" i.e., manganese hydroxide. Applicants respectfully traverse this rejection as follows.

The present application was filed as a 35 U.S.C. § 371 U.S. national phase application of PCT application No. PCT/JP01/02907, filed April 3, 2001. An English translation of the PCT application was filed upon entering the U.S. national phase. Accordingly, since the 35 U.S.C. §102(e) filing date of Tamagawa, October 2, 2001, is subsequent to the filing date of the present

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application, Tamagawa is not prior art against the present application, and withdrawal of the §102(e) rejection based on Tamagawa is respectfully requested.

Based on the above amendments and remarks, it is respectfully submitted that the claims of the present application are patentably distinct from the prior art of record and in condition for allowance. A Notice of Allowance is respectfully requested.

Respectfully submitted,

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(Date)

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Enclosures [Amendment Transmittal]